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REMARKS

Favorable reconsideration of this application in view of the remarks to follow and allowance of the claims of the present application are respectfully requested.

Applicants added two new dependent claims, viz., Claims 13 and 14. Support for the subject matter in these claims is found on page 7, line 17 to page 10 line 16 of the instant specification.

No new matter is added to the application.

The Official Action dated Sept. 8, 2006 ("Official Action"), has rejected Claims 7-12 under 35 U.S.C. §103(a) as defining subject matter, which allegedly rendered obvious by the teachings of U.S. Patent No. 6,103,392 to Dorfman et al. ("Dorfman").

Specifically, the Official Action alleges that Dorfman "discloses preparing a W-Cu composite poweder comprised of W and Cu powders using tungsten and copper oxides..., compacting the W-Cu composite powder to the W-Cu composite material, densifying the W-Cu composite material and sintering the W-Cu composite material using T parameters that substantially overlap those as claimed by Applicant..." Pages 2-3 of Official Action. The Official Action further alleges that Dorfman "...teaches sintering embodiments with isothermal holds..." In addition, it alleges that Dorfman " teaches general solid- state and liquid-state sintering methods..., but does not limit sintering to processes with isothermal holds. The Official Action concludes that it would have been obvious to one of ordinary skill in the art to select a time of sintering in order to densify and form a rigid skeleton of materials. Page 4 of the Official Action. However, the Official Action admits that Dorfman does not teach a second sintering step without an isothermal hold, as claimed. Page 3 of Official Action.

Applicants respectfully submit that the claimed invention is not rendered obvious by the teachings of Dorfman.

The present application is directed, inter alia, to a method for a W-Cu composite material without exuding of Cu comprising the steps of

(a) preparing a W-Cu composite powder comprised of W and Cu powders prepared by mixing $WO_3/WO_{2.9}$ powder and CuO/Cu_2O powder;

(b) compacting the W-Cu composite powders to a W-Cu composite material;

(c) densifying the W-Cu composite material by holding the W-Cu composite material at a temperature of about 800 to about 1083°C under a reduction atmosphere; and

(d) sintering the W-Cu composite material at a temperature ranging from about 1200 to about 1400°C without an isothermal hold.

Dorfman discloses the process for solid state sintering comprising: initial sintering at a temperature in the range of 900-1000°C; spreading of copper and the formation of a monolayer copper coating on tungsten particles between 1000-1083°C, whereby the solid-state sintering can be influenced by i) the submicron particle size and ii) recrystallization and sintering temperature $T=0.3T_m$. (Column 3, Lines 3-15).

On the other hand, the liquid state sintering process comprises: effecting a particle rearrangement grain growth by a dissolution-reprecipitation mechanism and the formation and densification of a rigid skeleton. The liquid state sintering can be influenced by i) the size of tungsten particles; ii) grain shape accommodation; and iii) the amount of liquid phase (Column 3, Lines 35-57).

However, Cu bleedout occurs at the liquid-phase sintering stage in Dorfman. In order to eliminate Cu bleedout, Dorfman discloses reducing the rate of temperature increase

during the solid state stage. However, as shown hereinbelow, this methodology is not always effective for preventing copper bleedout, especially at the higher concentrations of copper in the composite material.

The present invention effects the prevention of copper bleedout by a totally different methodology, which includes a combination of two heating steps: 1) densifying the W-Cu composite material by holding the composite material at a temperature of about 800°C to 1083°C under a reduction atmosphere, as recited in Claim 7, or at 1083°C to 1150°C, as recited in Claim 9, and 2) then sintering the W-Cu composite material at a temperature ranging from about 1200 to about 1400°C without an isothermal hold.

Although Dorfman discloses various holds in its processes, there is no specific teaching or suggestion of specifically choosing the specific heating steps of the sintering process, as claimed. There is no specific passage in Dorfman that recognizes the specific conditions recited in the combination of heating steps. Moreover, it does not recognize the unexpected advantages achieved by conducting the second heating step in the sintering method from about 1200 to about 1400°C without an isothermal hold, as claimed. More specifically, the claimed invention includes a second heating step of "sintering the W-Cu composite at 1200-1400 °C without isothermal hold" to restrain a W grain growth. Further, in order to achieve the a complete densification performed by such quick sintering, the process of the present invention includes a first step of holding the W-Cu composite for a certain time at a Cu solid state temperature or at a temperature just above a melting point of Cu, as claimed in Claims 7 and 9. The first step aids in finishing W particle rearrangement in the very short time and results in restraining W gain growth. The present invention is directed to a combination of the first and second heating steps as discussed above.

Dorfman does not teach or suggest such combination. Further, Dorfman discloses a sintering cycle, which consists of a combination of temperature increases and isothermal holds. See Dorfman, Col. 13, lines 26-30. More specifically, Dorfman discloses a step in which there is a temperature increase rate of 10°C/minute between 120 minute isothermal holds at 850, 950, 1050, 1100, 1150, 1200 and 1250°C. Thus, Dorfman teaches and discloses an isothermal hold at two temperatures between 1200 and 1400°C, viz., 1200 and 1250°C. In this respect, Dorfman et al. teach away from the present invention by requiring isothermal holds at 1200 and 1250°C. It does not recognize conducting the sintering step without an isothermal hold between the temperatures of 1200 to 1400°C. Dorfman does not teach or appreciate the advantages of the second heating step in the sintering process between 1200-1400°C without an isothermal hold.

To illustrate these advantages, attention is directed to Figures 5A, 5B, 6A and 6B in the instant application, a magnification of which is attached to the response. As a representative example, a composite powder was prepared where it contains 45% Cu. Figures 5A and 6A show the results of the sintering steps, when the W-Cu composite material undergoes heating in a second step at 1200°C for 60 minutes, (i.e. with an isothermal hold). As clearly shown by the figures, there is a Cu bleedout of the copper under these conditions. In contrast, attention is directed to Figures 5B and 6B wherever the second heating step is conducted at between 1200 and 1400°C without a isothermal hold. As clearly shown, there is no copper bleedout under these conditions.

Thus, the data clearly evidence that the present methodology represents a patentable departure from the teachings of Dorfman.

The Official Action alleges that it would have been obvious for one of ordinary skill in the art to select a time of sintering from Dorfman's broader disclosure of solid-state and

liquid-state sintering in order to densify and form a rigid skeleton in the composite material. However, Dorfman does not disclose the combination of heating steps in the sintering process, as claimed or the advantages associated therewith. Thus, based on the teachings of Dorfman, contrary to the allegations in the Official Action, one of ordinary skill in the art would be unable to deduce the combination of heating steps, as claimed, especially since this combination cannot be determined from merely selecting a time of sintering from the disclosure of Dorfman.

With respect to the added dependent Claims 13 and 14, the above arguments are also applicable and are incorporated herein. In addition, there are additional arguments for the patentability thereof. Applicants respectfully submit that Dorfman only discloses the sintering of W-Cu composite wherein the Cu content ranges from 2 to 25 wt.%. See Column 10, Lines 24-28, Column 14, Lines 52-58, Column 15, Lines 19-23, and Lines 61-63, and Column 16, Lines 4-14. It is limited to a maximum copper content of 25%, and does not teach, disclose or suggest that the process would be effective for composite wherein the Cu content is grater than 25%. Thus, it is not obvious to one of ordinary skill in the art to expect that a W-Cu composite with Cu content ranging from 35-45 wt% would be able to be sintered without copper bleedout as shown in Figures 2, 5B, and 6B of the present application. For this additional reason, Claims 13 and 14 are nonobvious over Dorfman.

Thus, for the reasons provided herein, the first rejection of the claims under 35 U.S.C. §103 is obviated; withdrawal thereof is respectfully requested.

The Official Action has further rejected Claims 7-12 under 35 U.S.C. §103(a) as allegedly defining subject matter, which is rendered obvious by the teachings of U.S. Patent No, 5,686,676 to Jech et al. ("Jech").

Jech discloses a sintering regimen involving, inter alia, heating a green compact

(formed from copper and tungsten containing particles, chemically bound oxygen and an organic binder as described in column 8, lines 52-64), at a temperature ranging from room temperature to about 1050°C over an hour, maintaining the temperature of the compact at 1050°C to 1250°C for about 50 minutes, and then decreasing the temperature of the composite so formed back down to room temperature over an additional 50 minutes. See Column 9, lines 46-54 in Jech. Jech does not teach or describe how to restrain Cu bleedout by the present invention.

There are many differences between the process described in Jech and the present process. For example, Jech does not suggest or disclose the two heating steps recited in steps (c) and (d) of Claims 7 and 9, which require densifying the composite material by heating the W-Cu composite material at 800°C to 1083°C under a reduction atmosphere, as recited in Claim 7 or at 1083°C to 1150°C as recited in Claim 9 and then sintering the W-Cu composite material <u>at a temperature ranging from about 1200°C to about 1400°C without an isothermal hold</u>. In Jech, the second heating step occurs at a temperature maintained between 1050°C and 1250°C. In other words, there is an isothermal hold in that region. <u>See</u>, for example, Examples 1 and 5 where the temperature of the second heating step is maintained at a temperature of 1140°C and Examples 2-4 wherein the temperature of the second heating step is maintained at 1210°C. Thus, in Jech, the second heating step is conducted at a temperature which is less than the temperature of the second heating step of the present process or if it is above 1200°C, it has an isothermal hold between 1200 and 1250°C. To that extent, Jech teaches away from the present process. Thus, Jech does not teach or appreciate the advantages of conducting the second heatings step at a temperature ranging from about 1200°C to 1400°C without an isothermal hold. Again, reference is made to the data in Figures 5A, 5B, 6A and 6B, which illustrate that there is a copper bleedout when the second heating step is effected at 1200C without an additional hold.

Therefore, for the reasons provided, the present invention represents a patentable departure over Jech.

Thus, the present process is not taught, disclosed or suggested by the teachings of Jech et al. Consequently, for the reasons enumerated herein, the present process is patentable over the teachings of Jech et al.

Further, Jech discloses using various organic additives and active sintering agents such as cobalt for purpose of enhancing densification (Column 6, Lines 1-45). Not only is it known to one of ordinary skill in the art that said additive abases electrical and mechanical properties of the composite, but Jech does not teach, disclose or suggest that the present sintering process can be effected with the combination of the two heating steps described hereinabove, in accordance with the present invention.

Thus, for the reason provides the rejection of Claims 7-12 under 35 U.S.C. §103 is obviated and withdrawal thereof is respectfully requested.

Thus, in view of the foregoing amendments and remarks, it is respectfully submitted that the present application is in condition for allowance, which action is earnestly solicited.

Respectfully submitted,

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Enclosure (Fig. 5A-6B)